Pervasive Navigation System for Transportation

Ph. D Synopsis

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INTRODUCTION

Satellite based navigation [1] is a leading-edge technology which allows anyone with a receiver to determine their position very accurately at any time by picking up signals from a constellation of several satellites. Navigation is a field of study that focuses on the process of monitoring and controlling the movement of a craft or vehicle from one place to [2] other. Navigation includes four general categories: space navigation, aeronautic navigation, marine navigation, and land navigation [3]. It is also the term of art used for the specialized knowledge used by navigators to perform navigation tasks. A navigator is the person on board a ship or aircraft responsible for its navigation. The primary responsibility of navigator's is to be aware of aircraft [4] or ship position at all times. All navigational techniques involve locating the navigator's position compared to known locations or patterns. In a broader sense, navigation can refer to any study or skill that involves the determination of direction and position. In this sense, navigation includes pedestrian and orienteering navigation.

Transport or transportation is the movement of animals, goods and people from one location to another. There are the several mode of transportation are like road, rail, air, water, cable, pipeline, and space. Traffic congestion is [5] increasing on both rail and road transport networks throughout Europe and scope to build additional network capacity is both limited in terms of land availability and expense. Research indicates that providing more road space leads to further demand, which in turn reduces capacity and increases congestion. So some new methods are required for managing the efficient use of rail and road networks and operation of the existing infrastructure. The development, deployment and continual improvement of Global Navigation Satellite System (GNSS) [6] has been of great significance to the design and development of intelligent Transport Systems (ITS) in recent years. Further enhancements of navigation technology will develop existing and encourage new intelligent transportation system world wide.

The navigation system like global positioning system (GPS) will provide the transport enterprises with tools to monitor and control operations of their vehicles and manage their fleet in an efficient and cost effective way. It will also provide the opportunity to customers with reliable, up-to date information on the transit status through text messages and map. A major component of such service is travel time/location information, i.e. the time when a vehicle will reach desired location, or the location where a vehicle will be at specific time. The provision of timely and accurate transit travel time/location information is important because it attracts additional users and increases the satisfaction and convenience of transit users.

The sample data is taken from Indian transportation for experimental study. The Pervasive navigation system for transportation will be a standalone system design to display the real-time location of the buses. This capability will allow passengers save their waiting time at the bus stops. It will allow passengers to request the current location and scheduled arrival time of the next bus to arrive at the stop. It will attract additional users and increases passengers' satisfaction. Passengers may also view all real-time bus locations on a map with their cell phone, laptop and desktop computers using web browser and with text messages. The system will be consist mobile phones, server, GPS, Internet and map of the Indian transportation routes.

LITERATURE REVIEW

2.1 History of Navigation system

Gerhard *et. al.* [7] It was in 1915 when the German scientist Alfred Wegener published the "The Origin of Continents and Oceans" outlining the concept of continental drift for the first time. This theory called Pangaea, because all the continents on Earth had formed from one single mass about 300 million years ago. Later on, Pangaea had divide, and its pieces had been moving away from each other ever since. Where such continental plates collide, mountain ranges may be pushed up, like for example the Alps that are the collision product of the African and the Eurasian plate. The introduction to Peter Apian's Geographia from 1533 illustrates that positioning in the "good old times" in essence meant measuring angles –the scale was eventually introduced by one known distance between two sites (as indicated by the symbolic measurement rod in the centre of the wood-cut).

Currently, the United States [1] Global Positioning System (GPS) and the Russian GLONASS system are the only operational Satellite navigation systems. Europe has begun the development of a third independent global system, known as 'Galileo'. Satellite navigation system like GPS is capable of providing a highly accurate, continuous, global navigation service independent of other positioning aids. GPS provides position, velocity and timing information in 24 hours, all-weather conditions and worldwide coverage. The system uses 24 operational satellites to provide a receiver with at least six satellites in view at all times. A minimum of four satellites in view are needed to allow the receiver to compute its current latitude, longitude, altitude and time. With this information the user's receiver can also calculate other parameters such as its velocity and acceleration. Any satellite navigation system has three parts: The Control segment, The Space segment and The User segment. All these parts operate together to provide accurate three-dimensional positioning, velocity and timing data to users worldwide. The Space Segment: The GPS system constellation has 24 satellites in six 55° orbital planes, each plane contains for satellites, with room for spares. The orbit period of

each satellite is approximately 12 hours at an altitude of 20,183 kilometers. With this constellation, a user receiver has at least six satellites in view from any point on earth. Other systems use satellites in different orbital periods and orbits. The Control Segment: The GPS control segment consists of a master control station, five base stations and three data up-loading stations in locations round the globe. Other configurations are possible for other satellite navigation systems. The User Segment: User receivers can be referred to as the User Segment, and consist of equipment which track and receive the satellite signals. User receivers must be capable of simultaneously processing the signals from a minimum of four satellites to obtain accurate position, velocity and timing measurements. However accuracy and reliability is enhanced as the number of visible satellites increases.

Navigation [8] is the part of migration. Biologists still do not know how they find the way thousands of miles to the exactly same place every year. Yet, there are four theories that are accepted the most by biologists. **Use of the sun:** Birds [9], like humans, possess an internal circadian clock that allows them to track the daily light-dark cycle. Birds also use the sun's shadows to gain a sense of location. **Use of the stars:** sun is not available at night as a guide so, many birds migrate at night. These nocturnal migrants have learned to use the stars for navigation. In the northern hemisphere, the constellations become visible to rotate around the North Star. Birds can orient themselves in relation to the North Star, and unlike the sun-compass, this "star-compass" is not time dependant. **Use of the earth's magnetic field:** Biologists have two different theories on how birds can use the earth's magnetic field to navigate. In first theory birds have certain pigments in their eyes that become weakly magnetic when they absorb light and thus alter certain nerve signals which the eyes send to the brain. In second theory which is most popular, comes from the fact that scientists have detected tiny crystals of magnetite along the olfactory tract in the brains of some birds. **Use of visual landmarks:** The idea of birds using landmarks to navigate had long been a popular theory. Many birds have been known to follow visual clues such as mountain, coastlines, and rivers ranges in order to arrive at the correct destination. However, this idea does not explain how birds find their way during their very first migration without getting lost.

2.2 Maps

A map is a visual representation of an area – a symbolic depiction highlighting relationships between elements [10] of that space such as themes, regions, and objects. Many maps are static two-dimensional, geometrically accurate (or approximately accurate) representations of three-dimensional space, while others are interactive or dynamic, even three-dimensional. Although geography maps such as DNA mapping, brain mapping, and extraterrestrial mapping are most commonly used to represent any space, real or imagined, without regard to context or scale. Road maps are subset of navigational maps and most commonly used maps today, which also include nautical and aeronautical charts, hiking, railroad network maps and bicycling maps. In terms of quantity, most of drawn map sheets are probably made up by local surveys, carried out by utilities, municipalities, tax assessors, emergency services providers, and other local agencies. Maps of the world/large areas are often either 'political' or 'physical'. The main purpose of the political map is to show territorial borders; the purpose of the physical is to show features of geography such as mountains, soil type or land use including infrastructure such as roads, railroads and buildings. Topographic maps show elevations and relief with contour lines or shading. Geological maps show not only the physical surface, but characteristics of the underlying rock, fault lines, and subsurface structures. From the last quarter of the 20th century, the indispensable tool of the cartographer has been the computer. Most of cartography, especially at the data-gathering survey level, has been subsumed by Geographic Information Systems (GIS). The functionality of maps has been greatly advanced by technology simplifying the superimposition of spatially located variables onto existing geographical maps. Local information within the map having such as distribution of wildlife, rainfall level or demographic data integrated allows more efficient analysis and better decision making.

2.3 GPS (Global Positioning System)

Bradford *et. al.* [11] The satellite-based Global Positioning System (GPS) has been called the ninth utility. Knowing where you are to the width of a street has spawned a

host of new technologies, new uses, and new industries. With a current commercial production rate of over 60,000 sets per month, this system is perhaps the most significant civil spinoff of the cold war. This operational GPS is the product of the imaginations of a small group of U.S. Air Force officers and supporting civilians, meeting in the Pentagon, over the long Labor Day weekend of 1973. But those imaginations were inspired by a rich history of prior proposals and technology, which had been developed by many talented people. The American public was both fascinated and shocked in October of 1957 to find that the Soviet Union had launched the world's first artificial space satellite, known as Sputnik. On Nov. 3, in the same year, a second jolt occurred with the launch of another Soviet satellite. Sputnik 2 weighed 508 kg and included a dog named Laika. At the same time the U.S. suffered through a series of humiliating launch failures. Finally, on Jan. 31, 1958, Wernher von Braun and the Army Ballistic Missile Agency launched the tiny (13.6 kg) Explorer 1 satellite. This began the U.S.'s venture into space. In the infancy of that era we were ignorant of many of the essential technologies and processes needed for a successful space program. Component reliability, space radiation, and orbit determination were all opportunities to gain new knowledge. In this quest were found the keys to the development of the first space-based navigation system.

2.4 Transportation systems

The first earth tracks were [12] created by humans carrying goods and often followed game trails. Tracks would be naturally created at points of high traffic density. Several animals became elements in track creation like horses, oxen and donkeys were domesticated. With the growth of trade, tracks were often flattened or widened to accommodate animal traffic. Later, the travois, a frame used to drag loads, was developed. In the 4th or 5th millennium BC and spread to Europe and India in the 4th millennium BC and China in about 1200 BC animal-drawn wheeled vehicles probably developed in Sumer in the Ancient Near East. The Romans had a significant need for good roads to extend and maintain their empire and developed Roman roads. John Loudon McAdam (1756–1836) designed the first modern highways, for the Industrial Revolution, using inexpensive paving material of soil and stone aggregate (macadam),

and he embanked roads a few feet higher than the surrounding terrain to cause water to drain away from the surface. With the development of motor transport there was an increased need for hard-topped roads to reduce washaways, bogging and dust on both urban and rural roads, originally using cobblestones and wooden paving in major western cities and in the early 20th century tar-bound macadam (tarmac) and concrete paving were extended into the countryside. In 1970 a Modern bicycles invented, in 1967 a First motorcycle invented, in 1871 First cable car invented, in 1903 The Wright Brothers invent and fly the first engined airplane, in 1907 Very first helicopter - unsuccessful design and in 1964 Bullet train transportation invented. In 1662 Paris and France originated first omnibus for public transit system, although the service in question failed a few months after its founder died; omnibuses are next known to have appeared in Nantes, France, in 1826. The omnibus was introduced to London in July 1829. The rail transport [13] in India began in the mid-nineteenth century. In 1849, there was not a single kilometer of railway line in India. By 1929, there were 66,000 km (41,000 mi) of railway lines serving most of the districts in the country. At that point of time, the railways represented a capital value of some British Sterling Pounds 687 million, and carried over 620 million passengers and approximately 90 million tons of goods a year. In 1966, when Haryana was carved out of Punjab there arose a need of separate transport unit which would connect every part of the state with other parts effectively. So, HRTL was [14] established with two Regional Transport Authorities in 1966. Three RTAs were appointed at Ambala, Hisar and Faridabad in December 1, 1987. Other three more RTAs were created at Rohtak, Karnal and Rewari in January 16, 1991. Haryana Roadways provide its services for passenger transport in the State. It has approximately 3500 buses being operated by 20 depots, each headed by a General Manager, and 17 sub-depots functioning under the depot concerned. These services are being provided to every part of the State as well as to important destinations in the neighboring States. Haryana Roadways carries 1.12 million passengers daily on 1116 Intra-State and 446 Inter-State routes and plies on an average 1.11 million Km every day. The state has decided to augment its fleet by 4,100 by the end of year 2012.

Bratislav Predic *et. al.* [15] The recent advances of automatic vehicle location (AVL) systems based on global positioning system (GPS) have provided the transit industry and public transport enterprises with tools to monitor and control operations of their vehicles and manage their fleet in an efficient and cost effective way. It has also provided the opportunity to provide customers with reliable, up-todate information on the transit status through traveler information services (TIS). The provision of timely and accurate transit travel time/location information is important because it attracts additional users and increases the satisfaction and convenience of transit users. Such reliable real-time information assists the customer in making their transit and multimodal trip plans and enables them to make better pre-trip and en-route decisions. Some research on this topic has been conducted and presented in the literature, but more research is required and has to be done to further improve reliability and effectiveness of traveler information services. This model to predict bus motion and bus arrival time using AVL data and historical data on previous bus motion along the same route. Our travel time prediction model includes static bus schedule data and schedule adherence, bus motion and traffic flow histories divided in classes depending on time of the day/week, as well as real-time traffic events such as traffic congestions, jams and bus breakdowns that have influence on bus motion and arrival times. The model and algorithms for prediction of bus motion are based also on vector data for bus lines/routes, bus stops, and road network with segments and junctions AVL systems are a diverse set of systems with various functionalities dealing with spatiotemporal data acquired from moving objects of point type. Core components of such systems are component tasked with calculating geographical location of the vehicle and component tasked with transferring this information to the control centre using some wireless telecommunication technology. This concept proved to be the most reliable end cost effective. City service implementing bus tracking is therefore not required to implement custom sensors for detecting bus stops and independent wireless telecommunication network.

MyBus [16] is the result of the scientific project realized in the laboratory for the intelligent transportation systems at the University of Washington. Busses' location and velocity data is firstly streamed through Kalman filter and further matched to the

geometry of the line the bus is operating on. This algorithm divided the complete line route into smaller segments. The segments are small enough that it reasonable to assume that the vehicle has constant speed on that segment. Final estimated time is calculated as a sum of calculated times per segment [17].

NextBus [18] is an example of a commercial system that is in use in several cities in the USA. The system is based on analysis of vehicle position data from the AVL acquired by GPS positioning. Since NextBus is a commercial product more detailed description of the prediction algorithm is not freely available but this project is a good example of how information produced by analysis of busses motion (arrival time prediction) can be distributed to travelers using WEB, WAP, SMS or public information displays installed at bus stops.

Bashir Shalaik *et. al.* [19] The main element of transport information services is predicting the arrival times of the next bus and providing this information to the public via various media. Due to the different operational conditions, the technologies used for arrival time estimation in transit modes such as rail systems can not directly be transferred to fixed route bus services. Rail transit is a well controlled mode; vehicles have few external factors interfering with their progress and their locations are tracked as a matter of course for safety, signaling and other reasons. External sensors are required to determine as accurately real-time locations of buses, so bus location or arrival time information often has a degree of uncertainty. Causes of this uncertainty are traffic congestion, intersection delays and weather condition. These are force buses to deviate from their schedules and headways and can result in poor services and increase in the length of passenger waiting-times as stops. Providing accurate real-time arrival information enhances the credibility of public transit systems and makes them more competitive against other transportation modes. GPS devices have become the central technology enabling this function and allowing travel and arrival time data to be comprehensively collected. Additionally, recent advances in cheap mobile communication have made it possible to transmit GPS data via GSM/GPS technology to a central serve inexpensively using public networks. This data can be displayed and

visualized through different media such as PDAs, mobile phones or web brewers in a real-time environment. One major use of this data is to provide vehicle arrival time predictions for passengers along the route. Real time bus tracking systems are arrangement of the installation of a location-aware transmitter on a bus plus purpose-designed computer software to collect the data and enable its storage, display and analysis. Modern bus tracking systems commonly use GPS technology can also be used. With the help of web browser or specialized software the real time location of buses can be viewed on electronic maps and diagrams.

2.5 Pervasive and Ubiquitous Systems

The term "Ubiquitous Computing" was first coined in 1988 by Mark Weiser. Mark Weiser [20] in his 1991 visionary paper "The Computer for 21st Century" laid the foundations of pervasive computing. Later on ubiquitous computing became famous as Pervasive. Pervasive networking is said to be evolved from Distributed computing and Mobile computing. Pervasive computing also known as ubiquitous computing is the growing trend towards embedding microprocessors in everyday objects so they can communicate information. The terms pervasive and ubiquitous indicate "existing everywhere." Pervasive computing aims to seamlessly [21] combine computing and communication with our environment so as to make our day-to-day activities the central focus rather than the computing or communication devices per se. Last decade has seen a steady increase in the momentum for his ideas. This is probable only due to dramatic increase in the availability of personal digital assistants (PDAs), wireless networking solutions, and embedded computing devices. For example, wirelessly connected organizers and smart phones are becoming popular, and digital computing in some form is now an integral part of numerous everyday appliances. Pervasive computing devices are completely connected and constantly available. Pervasive computing relies on the convergence of advanced wireless technologies, Internet and the electronics. The main goal of researchers working in pervasive computing is to create smart products that communicate unobtrusively. The products are connected to the Internet and the data they generate is easily available.

CASE STUDIES

3.1 Case study 1: Rail Radar System

3.1.1 Introduction

Railway Information Service (CRIS) and RailYatri team (Stelling Technologies) developed the RailRadar application. This application can access by users from their mobile phones, via the device's browser. The Rail Radar [23] system, a live tracker of the trains, was developed by PSU Centre for Railway Information System (CRIS) in a tie-up with Rail Yatri. The system will provide the user to track train timings, locations, routes and stoppages. "You have no need to keep in mind train numbers," the official said to Press Trust of India, adding "just enter any two station names (like Delhi to Bhubaneswar) and it will bring all the available trains on that route." Currently, the system is introduced as a pilot project and would soon become a permanent facility in the country. The Rail Radar works using a colour code system. If a person tracks a train status by giving necessary information, the trains will be highlighted either red or in blue. The blue shows that the train is on time while red indicate out that the train is running behind the scheduled time. Besides this, the zoom in and zoom out feature of the system will allow the user to see the exact station where the train was stopped and can also get the information like the expected time to reach a particular station and the departure time. The Indian Railways operates around 10,000 trains in the country.

3.1.2 Objective

The main aim of this application helps users find the exact geographical position of 6,500 passenger trains of the Indian Railways on Google Maps on a real time basis. This enquiry system allows the user to track train timings, locations, stoppages and routes. If the passengers want to track any train is not required to keep in mind the train number or the name, as just the entry of two station names will give the user details of the train. The figure 1 shows the Rail Radar system.

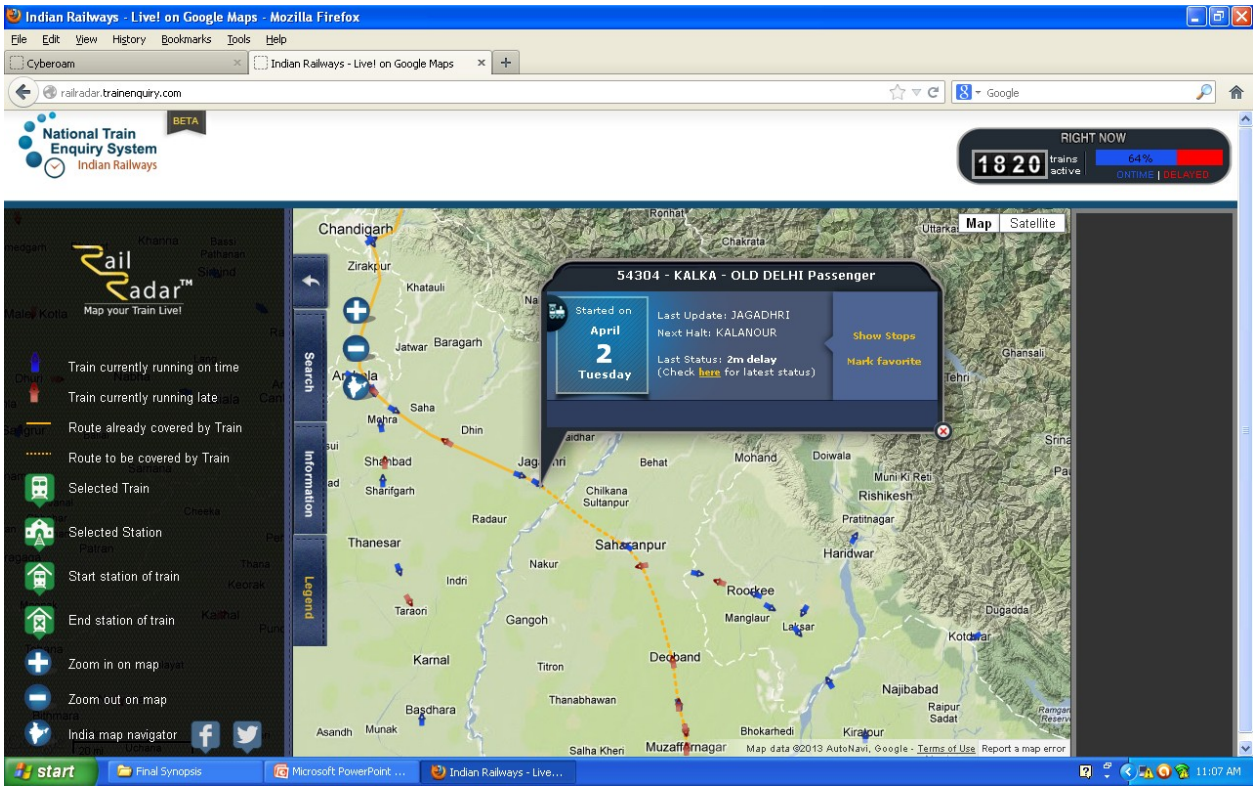

Figure 1: Rail Radar System

3.1.4 Features

- The system use a colour code method as trains highlighted in blue show those that train are running on time while the red markers points the trains that are delayed or behind schedule.
- When you click on a particular train, the map will display the exact route of the train including all the stoppages and the current location of the train on the real time basis.
- If passenger wants to know the current running status of the train, one can either enter the name of the train, or the train number if you remember it, and the system will tell you whether that particular train is delayed or running on time.
- One can also see all the trains which are arriving at the station or have just departed with the name of the station.
- This system provides live tracking of passenger trains traffic in real time.

3.1.5 Advantages

- GUI based application
- Save Time
- Save money
- Passenger can watch the movement of trains running across all parts of the country.
- Passenger can access the information at any time form any where.
- highly reliable

3.1.6 Disadvantages

- Security Threats
- Slow speed due to heavy graphics.
- Complex explains the website

3.1.7 Gaps

- Most of the Indian transportation system are not using the latest transportation Models.
- Presents system demonstrate a total failure in case of emergencies
- Present transportation Model are carrier oriented not goods oriented, exception is speed post.

3.2 Case study 2: Indian Postal Tracking System

Indian Postal Tracking System is proving by Govt. of India free speed post [24] tracking service. It provides online service to track your article that you sent to someone using speed post. India Post's online tracking allows you to access tracking information and confirm the delivery of your item by using the tracking number assigned to you at the time of Booking. You can find the tracking number on the Postal receipt handed over to

you at the Post office Counter at the time of booking. With the help of this system we can track the following articles. The figure 2 shows the Indian postal tracking system.

Figure 2: Indian Postal Tracking System

- Speed post (Domestic EMS)
- International EMS
- Electronic Money Order (eMO)
- Registered Mail
- Express Parcel
- Electronic Value Payable Parcel (eVPP)

3.2.1 Advantages:

- It is easy way to check status in one minute.
- Tracking speed post is free of cost.
- The Website is user friendly.

- Track both National and International Articles.

3.2.2 Disadvantages:

- **Delay in Final Report:**
  The complete updating of status of speed post article take 2-3 days. So you have to wait.
- **Goods oriented not carrier oriented:**
  This system is goods oriented, it provide the information of article at stations not between.
- **Email System Not Reliable:** The website says it sent an alert when there is an update about your speed post article but I never received one. I tried many time.

3.2.3 Gaps

- This system is only goods oriented not carrier oriented.

3.3 Case study 3: Haryana Roadways

3.3.1 Introduction

Haryana Roadways [25] is the principal service provider for passenger transport in the State. It provided services to every part of the State as well as to important destinations in the neighbouring States. Haryana Roadways plies on an average 1.11 million Km every day and carries 1.12 million passengers daily on 1116 Intra-State and 446 Inter-State routes. The state has decided to augment its fleet by 4,100 by the end of year 2012. Government of Haryana is committed [26] to make endeavors towards creating social value by providing efficient, reliable and eco-friendly modern transport services for the safe movement of people and goods with liberal use of modern day Information Technology and involvement of private sector, which is considered necessary in this era of liberalization and globalization. The cost of ticket is low and provides the fast service. Fix departure and arrival time of buses.

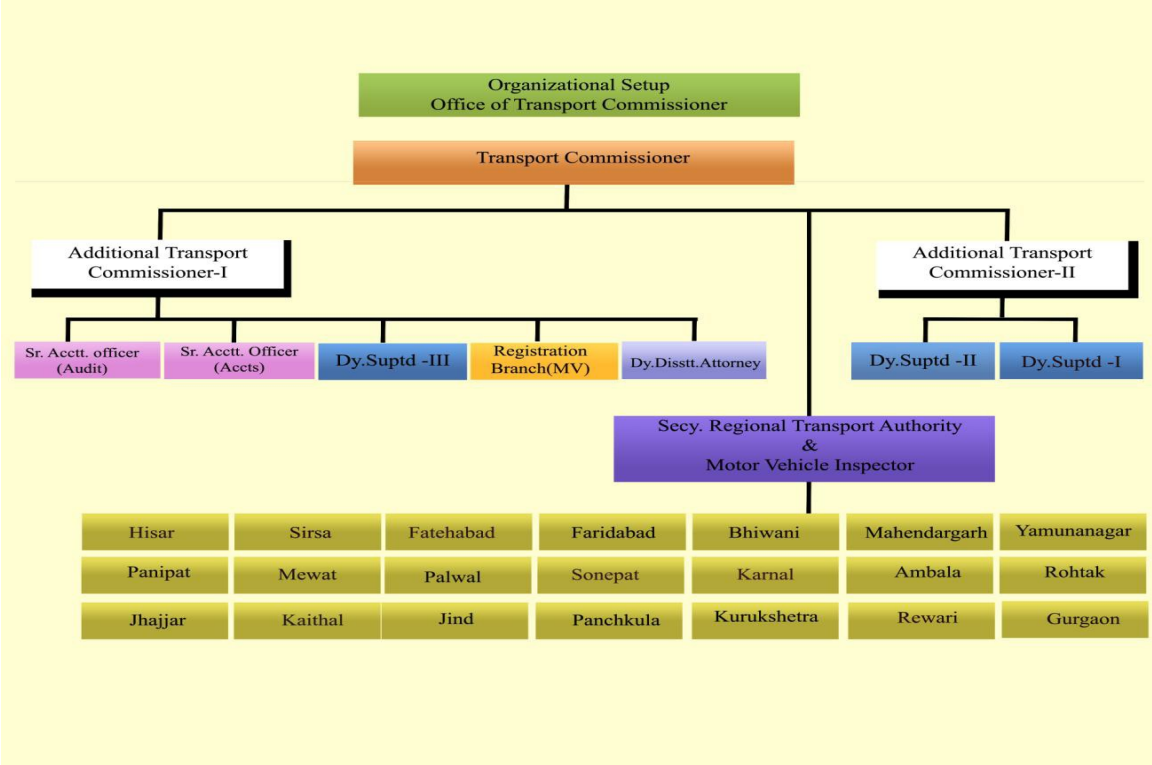

Figure 3: Haryana Transportation chart

3.3.2 Objective

Haryana Roadways is responsible for providing well-coordinated, economical, safe and efficient transport action services to the public of the State. Haryana Roadways, a State Government Undertaking, is the principal service provider for passenger transport in the State. It has a fleet of approx. 3500 buses being operated by 20 depots, each headed by a General Manager, and 17 sub-depots functioning under the depot concerned. These services are being provided to every part of the State as well as to important destinations in the neighbouring States.

3.3.3 Disadvantages

- Very poor bus navigation information system.
- Poor emergency hours service system.
- No provision for route diversion.

3.3.4 Gaps

- Design efficient bus navigation information system.
- Better emergency hours service system.
- Provision for route diversion
- We can be provide maximum passenger utilization
- Reduce traveling cost

3.4 Case study 4: Existing Transportations tracking system

NextBus [18]

3.4.1.1Objective

This system provides the passengers get up-to-the-minute arrival information wherever they are on any device they choose. Whether they are at home, in the office, in classes, out shopping or just on the run, they can find out exactly when the next bus will arrive. This makes for very satisfied customers. You can minimize service cuts and maximize passenger satisfaction with help from NextBus.

3.4.1.2 Feature

- They can set alerts to get them to their stops right on time.
- They can be alerted to emergency situations affecting their travel.

3.4.1.3 Advantages

- Increase efficiency
- Increase reliability
- Reduce costs
- Reduce complexity
- Reduce complaints
- Save money by optimizing exiting routes and schedules.

3.4.2.1 WaitLess Bus [27] The WaitLess bus tracking device is a standalone system that displays the locations of buses in real-time. This system, designed to be deployed at various bus stops around campus, is comprised of a solar power source, a battery, a microprocessor, LEDs, and a wireless internet link. The wireless internet link will be used to poll a live XML feed from the NextBus server (via GTwireless) that contains GPS data of each bus's location. The data will then be parsed by a microprocessor and used to illuminate tri-color LEDs that will represent each bus's location. This system will assist pedestrians in making the decision of whether to wait for the bus or walk.

3.4.2.2 Objective

The transit company responsible for providing the GPS locations of the Georgia Tech buses is NextBus [1]. Currently, NextBus provides Georgia Tech with scrolling LED panels with text indications of estimated bus arrival times. The WaitLess bus tracking device will be equipped with a LED embedded map of the Georgia Tech bus routes. This will serve as an alternative pedestrian notification system that NextBus could sell to the Georgia Tech transportation department, to be placed at each of the 40 bus stops. The bus tracking system will essentially be a "set and forget" system that requires little or no maintenance. It will be powered by a 12V battery which will be recharged by a solar panel to eliminate energy costs.

3.4.2.3 Methodology

The functional block diagram depicted in Figure 4 illustrates the holistic assembly, highlighting how each component interacts with other parts and executes its functional role.

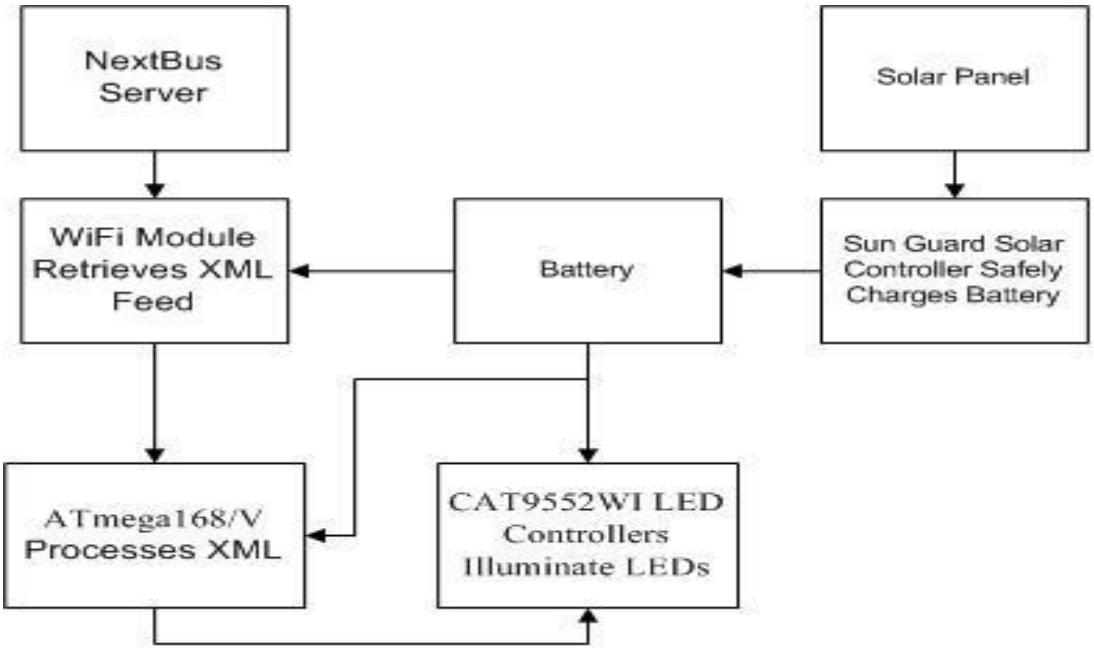

Figure 4: Block diagram for waitless bus system

3.4.2.4 Features

- LEDs will be placed along a map of Georgia Tech bus routes
- LEDs will light up to indicate the location of buses on two routes
- The whole system will be solar powered with a backup battery
- The device will be enclosed in a standalone weather-proof case with Plexiglas cover
- The system will use Wi-Fi internet to receive GPS locations

3.4.2.5 Advantages

- Completely self-contained with easy installation, no external wires required
- Low power, less than 500 mA current draw
- Target cost of prototype parts, less than $424
- Target labor cost to produce prototype, $6300

3.5 Research Gaps

- Either carrier oriented or goods oriented not both.
- Tracking system are discrete systems not continuous systems, which leads to improper estimation.
- High Cost
- Less provision for navigating in emergences(or no provision for route diversion)
- Widely used in foreign countries but not used in India.

PROPOSED WORK

4.1 Introduction

For experimental study the test data is taken from the Indian transportation. Navigation using smart phone is one of the hot research topics of information technology. We focus on public transit navigator where the system supports riding bus. Bus system is the fundamental public transportation system and has an important role in every province. However, with Pervasive Navigation System for Transportation, this information is provided in text-base. When passenger travels in transportation they suffer from various problems. It is difficult to understand them for the person who does not know the place. So there is the need to develop bus navigation system for transportation. The application will also inform the user the correct bus to get, the direction the bus takes and the fare, which ease worries people tend to feel when they take buses.

4.2 Motivation

Passengers often face the decision of whether it would be faster to wait for the next bus or to walk to his/her destination. Many passengers are often late to duty or job interview because they decide to wait for the bus instead of just simply walking. Some passengers who are not belonging to particular route they ask conductor and neighbor passenger continuously about own destination station. There are the several drawbacks of exiting systems which are given above and below.

- Most of populations (65%) are often late to their destination because they decided to wait for a bus instead of walking.

- On bus stops 85% of the population should be confirmed the position of the buses would be beneficial in deciding whether to walk or wait for the bus.

- 90% of the population should be confirmed the location of the buses is more indicative of wait time than an approximate arrival time.

If passengers had an easy way to see each bus's location, in real-time, they could make a more accurate, informed decision of whether or not to wait at a stop. This research would also be an improvement to the transportation service already provided, addressing the dissatisfaction with current wait times of the buses and many other several issues.

4.3 Features

- Estimate and display arrival times of Buses with text messages.
- Reduce waiting times at Bus Stops
- Helpful in case of road accident.
- This system will reduce the crowd into the buses.
- Very helpful during the times of Govt. Exam, festival and weekend.

4.4 Objective

- Latest Technology.
- Latest transportation model.
- Develop a system which provides both features carrier oriented and goods oriented.
- Provision for navigating in emergences (or provision for route diversion)
- Low cost
- Security and Authentication
- Estimating expected arrival time based on history of movement.

4.5 Frame work

Figure 5 shows the proposed prototype. For this system we put a mobile device and GPS device in each bus. The GPS device receives the information from satellites. The mobile phone device and GPS device are connected to each others. When the GPS device receives the information form satellite then it information to it's connected Mobile device. The mobile number is the unique id of each bus. After receiving the information the mobile bus device send to server. Server contains the record of Indian Transportation. There are the two types of users for this system. Frist types of users are mobile users which have no facility of internet

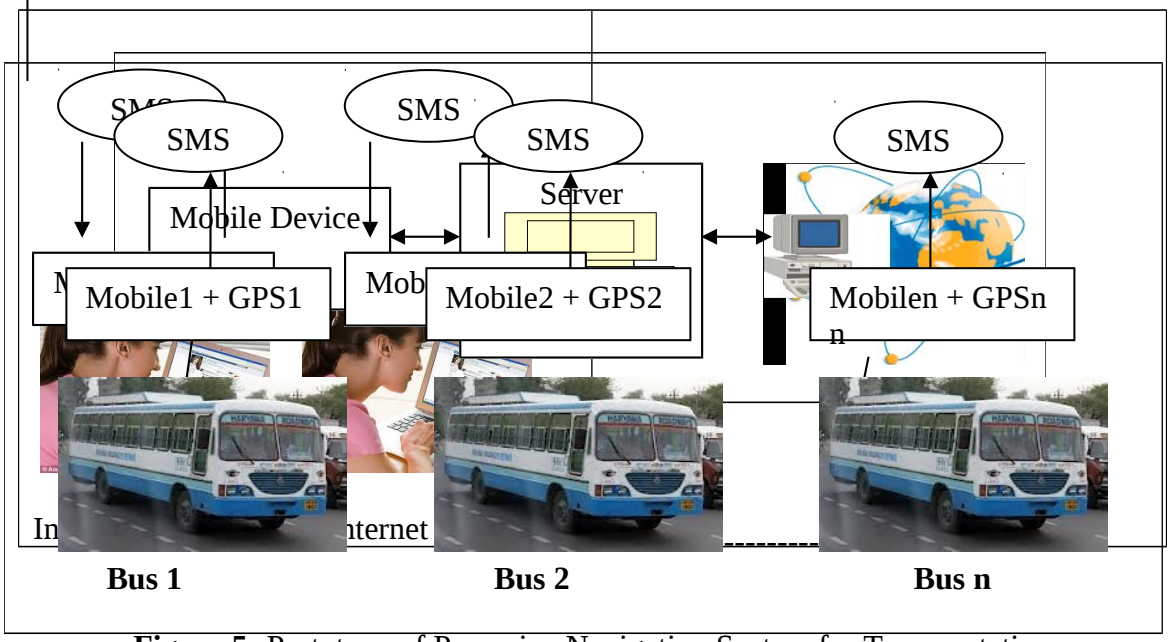

Figure 5: Prototype of Pervasive Navigation System for Transportation

or GPRS on their mobile phone. They can receive the transportation information directly at anytime and anywhere with the help of text messages, without any internet. Second types of users are internet users they can receives the information with the help of internet.

4.6 Requirements

The requirements are dived into the two parts: software requirements and hardware requirements.

4.6.1 Software requirements

For this application there two software's are required Arcmaps and ArcGIS. ArcMap users can create and manipulate data sets to include a variety of information. For example, the maps created in ArcMap [28] generally consist of features such as north arrows, scale bars, titles, legends, etc. The software packages consist of style-set of these features. The ArcGIS suite is available at three license levels: Basic, Standard, or Advanced (formerly ArcView, ArcEditor, or ArcInfo). Each step up in the license provides the user with more extensions that allow a variety of querying to be performed on a data set. ArcInfo is the highest level of licensing, and allows the user to use such extensions as 3D Analyst, Spatial Analyst, and the Geostatistical Analyst. Maps created and saved within ArcMap will create a file on the hard drive with an .mxd extension. Once an .mxd file is opened in ArcMap, the user can display a variety of information, as long as it exists within the data set.

4.6.2 Hardware Requirements

The hardware requirements are GPS device, Mobile phones, GPRS etc, Laptop/ Desktop pc.

4.7 Experimental Cost

The experimental cost for this system include the cost of GPS devices, Mobile phone devices, Text messages, internet cost etc. The approximately cost of one bus is 15,000 Rs. Suppose if experiment is done on single route form Yamuna Nagar to Delhi and 20 buses are in this route. So the total cost is 15,000*20= 300,000 Rs. for single route Yamuna Nagar to Delhi.

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